NRA 96-OEOP-1
Issued: November 27, 1995
Proposal Due: February 9, 1996

NASA RESEARCH ANNOUNCEMENT (NRA)

Faculty Awards for Research (FAR)

Soliciting Proposals for Basic and Applied Research in Support of NASA Strategic Enterprises

National Aeronautics & Space Administration
Office of Equal Opportunity Programs
Minority University Research and Education Division
Washington, DC 20546-0001

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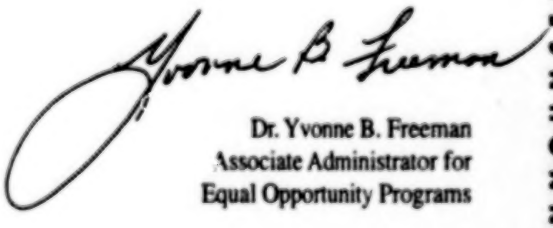
This NASA Research Announcement (NRA) solicits basic and applied research and analysis from faculty of Historically Black Colleges and Universities (HBCU's) and Other Minority Universities (OMU's), including Hispanic Serving Institutions (HSI's), that is relevant to one or more of the five NASA Strategic Enterprises described in the NASA Strategic Plan. The Strategic Enterprises are: Mission to Planet Earth; Aeronautics; Human Exploration and Development of Space; Space Science; and Space Technology. These strategic enterprises encompass a broad range of traditional science and engineering disciplines as applied to meeting NASA research objectives and mission needs. The goal of this program is to achieve NASA's mission while enhancing cultural diversity in the NASA-sponsored research community at institutions with significant underrepresented minority enrollment.

Participation in this program is open to tenured or tenure-track faculty of HBCU's and OMU's which offer degrees in engineering, mathematics, or science disciplines. Proposals which demonstrate effective partnerships or cooperative arrangements among Government, academia and industry will also be considered. Letters of Intent are due by January 12, 1996. Proposals are due by February 9, 1996. Proposals will be evaluated by peer and technical reviews during February and March of 1996.

Appendix A provides technical and program information in the general areas in which proposals are sought. Appendix B contains basic guidance for preparation of proposals in response to an NRA. Appendix C provides amendatory guidance applicable only to this NRA. Appendix D provides sources of additional information for this program. Appendix E contains copies of required forms.

Your interest and cooperation in participating in this Minority University Research and Education Program and the Faculty Awards for Research Announcement are appreciated.



Dr. Yvonne B. Freeman
Associate Administrator for
Equal Opportunity Programs

NRA 96-OEOP-1 SPECIFICS:

Identifier:

NRA 96-OEOP-1

Submit Letter of Intent to:

Ms. Deborah Russell
NRA 96-OEOP-1
NASA Headquarters
Code EU
Washington, DC 20546-0001

Submit Letter of Intent by:

January 12, 1996

Number Required:

1 Original and 1 Copy

Submit proposals by:

4:30 PM, local time, February 9, 1996

Submit Proposals mailed through U.S. Postal Service as first-class, registered, or certified to:

Ms. Deborah Russell
NRA 96-OEOP-1
NASA Headquarters
Code EU
Washington, DC 20546-0001

Submit proposals sent through commercial delivery (e.g., Federal Express) or hand carried to:

Ms. Deborah Russell
NRA 96-OEOP-1
NASA Headquarters
Attn: Receiving and Inspection
(Rear of Building)
Code EU
300 E Street, SW
Washington, DC 20024-3210

Number Required:

1 Original and 6 Copies

Selecting Official:

Associate Administrator for
Equal Opportunity Programs

For additional sources of information:

See Appendix D

Faculty Awards for Research

1. Program Overview

1.1 Introduction

NASA's Office of Equal Opportunity Programs, in response to a congressional mandate to meet NASA's research objectives and to increase diversity in the pool of Agency researchers, invites proposals for the NASA Faculty Awards for Research (FAR).

During FY 1996, approximately twenty Faculty Awards for Research will be selected for individual investigator research grants in NASA-relevant areas from NASA to universities with significant underrepresented minority enrollment. Universities with significant underrepresented minority enrollment are specifically targeted in order to enhance cultural diversity in the NASA-sponsored research community. These universities are targeted to assist the Agency in maintaining its leadership in space, Earth science, and aeronautical research by building a workforce including those who have been traditionally underrepresented in science and engineering research careers. Such universities should encourage outstanding and promising faculty, who have received a total of $250,000 or less of NASA research grants during the last 5 years, to submit a proposal.

Tenured or tenure-track faculty employed at eligible Historically Black Colleges and Universities (HBCU's) and Other Minority Universities (OMU's), including Hispanic-Serving Institutions (HSI's), are invited to apply. Approximately 10 awards will be made to HBCU faculty and 10 awards to OMU faculty. Awards in support of the planned research activities will be made for up to 3 years based on the annual progress toward accomplishing their goals and objectives and the availability of funds.

As a result of participating in this program, principal investigators will contribute directly to NASA research and support the development of socially and economically disadvantaged and disabled student researchers. Opportunities for participation in the Agency's mainstream research will expand as recipients' research capabilities are enhanced through interaction with NASA researchers and facilities. Additionally, the pool of socially and economically disadvantaged students (in particular those historically underrepresented in science, engineering and technology careers) with research experience and interest in pursuing advanced degrees in the fields of science, engineering and mathematics will increase through faculty support.

1.2 Program Goals and Objectives

The goal of this program is to achieve NASA's mission and enhance cultural diversity in the NASA-sponsored research community by supporting faculty and students at institutions with significant underrepresented minority enrollment.

Program objectives to accomplish this stated goal are as follows:

- Identify outstanding and promising engineering, physical and life science tenure-track faculty early in their academic careers, or faculty members who have limited past experience in NASA-sponsored research, as principal investigators who are capable of contributing to the Agency's research objectives and who have limited past NASA research grant experience.

- Provide such faculty members sufficient research support and exposure to the NASA peer review process to enable them to demonstrate creativity, productivity, and future promise in the transition toward achieving competitive awards in the Agency's mainstream research processes.

- Support these investigators with resources to provide research experience in NASA-related fields to graduate and undergraduate students, who are U.S. citizens, thereby increasing the pool from which NASA and the aerospace industry can draw.

1.3 Eligibility Requirements

1.3.1 Universities

Universities eligible to participate in this program must provide evidence that they offer degrees in engineering, mathematics or science disciplines relative to NASA's mission and meet at least one of the following criteria:

a. Be an accredited minority college or university with enrollment of a single underrepresented minority group or the combination of underrepresented minority groups that exceeds 50 percent of the total student enrollment as defined in the Higher Education Act as amended [see 20 USC 1135d-5 and 34 CFR 637.4(b)]; and/or
b. Be designated by the Department of Education in FY 1995 as an Hispanic-Serving Institution (HSI) under Title III of the Higher Education Act of 1965, as amended [See 20 USC 1059 (c); Public Law 102-325, Section 316, July 22, 1992]; and/or
c. Be designated by the Department of Education as an Historically Black College and University under Title III of the Higher Education Act of 1965, as amended (see 34 CFR 608.2).

1.3.2 Principal Investigators

Principal investigators (PI's) must meet the following criteria at the time the proposal is submitted.

a. Tenured or tenure-track faculty member of an eligible institution and
b. Ph.D. in an engineering, mathematics or science discipline applicable to NASA research needs and
c. U.S. citizen and
d. Received no more than $250,000 in NASA research awards during the last 5 years. Applicants who are or were Principal Investigators and/or Co-Investigators on NASA research awards must identify the amount of funding from such awards which support or supported their part of the research.

Note: Previous and/or current FAR recipients are not eligible to apply. Co-Investigators are not permitted.

1.4 Research Areas

Applicants may propose to conduct research in any engineering or science area which supports NASA's Strategic Enterprises. Discussion of proposed research with appropriate NASA Field Installation or Jet Propulsion Laboratory (JPL) personnel before submission of a proposal is strongly encouraged. A listing of appropriate initial contacts is given in Appendix D.

This solicitation is available electronically via the Internet at the following address: **http://mured.gsfc.nasa.gov/far.html**. The NASA Strategic Plan may be obtained from the World Wide Web at the following address: http://www.hq.nasa.gov/office/nsp/. Additional information on the Agency's engineering and other science areas may be obtained from the NASA homepage at http://www.nasa.gov, or by accessing FEDIX. FEDIX is a Federal exchange on-line data base retrieval service that includes information on NASA's programs. FEDIX can be accessed via Internet ["fedix.fie.com" or "192.111.228.33"] or via a toll-free data line [(800) 783-3349]. MODEM setup is 8 Databits, No Parity, 1 Stopbit.

1.5 Technical Monitors

A Technical Monitor from an appropriate NASA Field Installation, or JPL, will be appointed for each successful proposal. Proposers are encouraged to submit the names of individuals at NASA Field Installations or JPL, who have expressed specific interest in their proposal.

1.6 Support and Commitment

1.6.1 NASA:
Approximately 20 awards will be made based on merit reviews. Each award will consist of an annual grant of no more than $100,000 per year for up to 3 years in support of the proposed research activities. A minimum of 25% of the total budget each year must be direct support for U.S. citizen graduate and undergraduate students involved with the research project. NASA funding beyond the first year is contingent upon the submission of a satisfactory annual performance report and the availability of funds.

1.6.2 Universities:
Universities should clearly and succinctly identify any significant resources and/or other commitments and support of their faculty principal investigators. Applicants who are Principal Investigators or Co-Investigators on other current or pending grants from NASA or other funding agencies should clearly identify such grants and explain in detail how the work and funding from the various sources will complement each other.

1.6.3 Faculty Principal Investigators:
All principal investigators must maintain their status as full-time faculty members. The proposed research is to be conducted primarily at the university or at any institution or facility engaged in substantial NASA research. Faculty principal investigators are encouraged to coordinate their research with a NASA Field Installation or the Jet Propulsion Laboratory. They must also involve socially and economically disadvantaged and disabled graduate and undergraduate students who are U.S. citizens in their research. The NASA-related research activities may include support of research assistants, undergraduate student researchers, professional travel, research supplies and equipment, PI summer salary, and release time for conducting research.

1.7 Proposal Preparation Information

Proposals submitted in response to this NASA Research Announcement should follow the "Guidelines for Responding to NASA Research Announcements for Solicited Basic Research Proposals" (Appendix B)-except as augmented and superseded by the information given below and in Appendix C.

a. If substantial collaborations with other institutions are intended, letters of endorsement must be submitted by the responsible individuals from those institutions in an appendix. Each endorsement letter should indicate agreement with the nature of the collaboration detailed in the proposal which should be identified by title and date of submission.
b. All proposals must originate from a U.S. university or college which meets the designated criteria, and must reflect the unique combination of the applicant's interests and capabilities. The proposal should clearly identify the relevance of the research to NASA's mission. The university must submit written certification of its eligibility and faculty eligibility.
c. The "Length" section of Appendix B (Section 9) is modified to require that the proposal's investigation description be limited to 10 pages, and reviewers will be instructed and obligated to review only the first 10 pages of the description.
d. A total of 6 copies, numbered 1 through 6, must be received by the OEOP office by the deadline specified. A submitted proposal should be no more than 35 pages in length, using standard-sized paper (8" x 11.5"), one inch margins (top, bottom, left and right), 12 point font. Certifications, appendices, forms, and figures, *e.g.*, depicting research schedule, are desired, but must fit within

the 35 page limit. If a proposal is submitted printed 'double-sided', only 18 sheets of paper are acceptable, still totaling 35 printed pages. To facilitate the recycling of proposals after review, proposals should be submitted on plain, white paper only. This precludes the use of cardboard stock, plastic covers, colored paper, etc.

The proposal should be submitted according to the order listed and should not exceed 35 pages including certifications, forms, and appendices. Each proposal section listed below identifies the maximum number of pages for that section.

(1) Transmittal Letter. (1 page-see Appendix B, Section 7.1)
(2) Standard Proposal Cover Page. The proposal cover sheet must be signed by an institutional official who is authorized to certify institutional support and sponsorship of the investigation and of the management of the proposal. (1 page-see Appendix E)
(3) Table of Contents. (1 page)
(4) Certification of Institution and Faculty Eligibility. (1 page-see Appendix E)
(5) Supplementary Information Report. (1 page-see Appendix E)
(6) Certifications Regarding Lobbying, Debarment, Suspension and Other Responsibility Matters and Drug-Free Workplace Requirements. Each proposal must be accompanied by these institutional certifications expressing compliance with Federal regulations. A single certifications form is provided in Appendix E of this NRA. (2 pages-see Appendix E)
(7) Total Science or Engineering Degrees Awarded-from school submitting research proposal (1 page-see Appendix E)
(8) Proposal Summary Form. Include a brief (200-300 word) abstract of proposed research describing the objectives of the proposed effort and the method of approach. Include technical Enterprise interests and major accomplishments planned by the end of the period of performance (2 pages-see Appendix E)
(9) University Statement. Include a description of the university's support and resource commitments. (1 page)
(10) Project Description. Narrative should include the PI's research, evaluation, and transition plans. Plans should include objectives that are specific, measurable, achievable, and realistic within a stated time period. It should also include a detailed plan to substantially involve in the research socially and economically disadvantaged and disabled graduate and undergraduate students who are U.S. citizens. Details should include how these students will be tracked through completion of their degree. (10 pages-see Appendix B, Section 7.5)
(11) Principal Investigator's Research Qualifications (3 pages). Submit proposer's vitae, including academic record and listing of relevant publications. A single-page bibliography including no more than five publications relevant to the proposed research may be included as an appendix.
(12) Summary Budgets by Year and Cost Element. Include yearly budgets, a total budget for all 3 years, and explanatory notes for each line item. A minimum of 25% of the total budget must directly support socially and economically disadvantaged and disabled graduate and undergraduate students who are U.S. citizens. No single graduate student may receive more than $15,000 per year. Student support should be categorized under "Other Costs", section 2.f of the budget form provided. (6 pages-see Appendix E)

e. The "Proposed Costs" discussed in Section 7.9 of Appendix B is supplemented by the following information concerning proposal cost detail.

(1) The proposal should contain sufficient cost detail and supporting information to facilitate a speedy evaluation and award. Dollar amounts proposed with no explanation (e.g., Equipment: $5,000, or Labor: $23,000) may cause delays in funding should the proposal be selected. The proposed costing information should be sufficiently detailed to allow the Government to identify cost elements for evaluation purposes. Generally, the Government will evaluate costs in terms of their reasonableness and allowability. Each category should be explained. Offerors

should exercise prudent judgment, since the amount of detail necessary varies with the complexity of the proposal.

(2) Direct labor costs should be separated by titles or disciplines (e.g., Principal Investigator, clerical support, etc.) with estimated hours, hourly rates, and total amounts of each. Estimates should include a basis of estimates such as currently paid rates or outstanding offers to prospective employees. This format allows the Government to assess for reasonableness by various means, including comparison to similar skills at other organizations. Indirect costs should be explained to the extent that allows the Government to understand the basis of the estimates.

(3) With regard to other costs, each significant category should be detailed, explained, and substantiated. For example, proposed equipment purchases should specify the type of equipment, number of units, and unit cost. Requested travel allowances should include the number of trips, duration of each trip, air fare, per diem, rental car expenses, etc.

1.8 Schedule and Submission of Proposals

NASA Research Announcement Released	November 27, 1995
Letter of Intent Due	January 12, 1996
Proposals Due	February 9, 1996
Selection Announcement	March, 1996

The original and six (6) copies of the proposal package must be **received** at the indicated address **no later than 4:30 p.m. February 9, 1996**, to be considered for this year's awards. Please be advised that NASA cannot receive packages on weekends or federal holidays. Proposals will receive an acknowledgment of proposal receipt by return mail within 14 calendar days of the due date.

Reminder: Keep length to 35 pages.

NFSD 89-0 (JUNE 30, 1989)
PART 18-70

NASA SUPPLEMENTARY REGULATIONS

18-70.203 App. I

Guidelines For Responding To NASA Research Announcements For Solicited Basic Research Proposals. (NASA Office Of Procurement, August 1988)

1. Foreword

NASA depends upon industry, educational institutions, and other nonprofit organizations for most of its research efforts. While a number of mechanisms have been developed over the years to inform the research community of those areas in which NASA has special research interests, these instructions apply only to "NASA Research Announcements," a form of "broad agency announcement" described in 6.102(d)(2) and 35.016 of the Federal Acquisition Regulation (FAR). The "NASA Research Announcement (NRA)" permits competitive selection of research projects in accordance with statute while at the same time preserving the traditional concepts and understandings associated with NASA sponsorship of research.

These instructions are Appendix I to 18-70.203 of the NASA Federal Acquisition Regulation Supplement.

2. Policy

NASA fosters and encourages the submission of research proposals relevant to Agency mission requirements by solicitations, "NASA Research Announcements," which describe research areas of interest to NASA. Proposals received in response to an NRA will be used only for evaluation purposes.

NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA, to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

3. Purpose

These instructions are intended to supplement documents identified as "NASA Research Announcements." The NRA's contain programmatic information and certain "NRA-specific" requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRA's.

4. Relationship To Award

A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded on the basis of a proposal submitted in response to an NRA. NASA does not have separate "grant proposal" and "contract proposal" categories, so all proposals may be prepared in a similar fashion. NASA will determine the appropriate instrument.

Grants are generally used to fund basic research in educational and nonprofit institutions, while research in other private sector organizations is accomplished under contract. Additional information peculiar to the contractual process (certifications, cost and pricing data, facilities information, etc.) will be requested, as necessary, as the procurement progresses. Contracts resulting from NRA's are subject to the Federal Acquisition Regulation and the NASA FAR Supplement (NHB 5100.4). Any resultant grants or cooperative agreements will be awarded and administered in accordance with the Research Grant Handbook (NHB 5800.1C).

5. Conformance To Guidance

NASA does not have any mandatory forms or formats for preparation of responses to NRA's; however, it is requested that proposals conform to the procedural and submission guidelines covered in these instructions. In particular, NASA may accept proposals without discussion; hence proposals should initially be as complete as possible, and be submitted on the proposers' most favorable terms.

In order to be considered responsive to the solicitation, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation. NASA reserves the right to reject any or all proposals received in response to an NRA when such action is considered in the best interest of the government.

6. NRA-Specific Items

Several proposal submission items will appear in the NRA itself. These include: the unique NRA identifier, when to submit proposals; where to send proposals; number of copies required; and sources for more information.

Items included in these instructions may be supplemented by the NRA, as circumstances warrant. Examples are: technical points for special emphasis; additional evaluation factors; and proposal length.

7. Proposal Contents

The following general information is needed in all proposals in order to permit consideration in an objective manner. NRA's will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain
all submitted material, including a copy of the transmittal letter, if it contains substantive information.

7.1 Transmittal Letter or Prefatory Material

a. The legal name and address of the organization and specific division or campus identification if part of a larger organization;
b. A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;
c. Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;
d. Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;
e. Identification of any other organizations that are currently evaluating a proposal for the same efforts;
f. Identification of the specific NRA, by number and title, to which the proposal is responding;
g. Dollar amount requested of NASA, desired starting date, and duration of project;
h. Date of submission; and
i. Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

7.2 Restriction on Use and Disclosure of Proposal Information

It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE: Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal, the government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agree-ment). This restriction does not limit the government's right to use or disclose this information (data) if obtained from another source without restriction.

7.3 Abstract

Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective of the proposed effort and the method of approach.

7.4 Project Description

The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge in the field; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the general plan of work, including the broad design of experiments to be undertaken and an adequate description of experimental methods and procedures. The project description should be prepared in a manner that addresses the evaluation factors in these instructions and any additional specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Note, however, that subcontracting significant portions of a research project is discouraged.

When it is expected that the effort will require more than 1 year for completion, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should, of course, be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

7.5 Management Approach

For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and any necessary arrangements for ensuring a coordinated effort should be described. Aspects of any required intensive working relations with NASA Installations and/or the Jet Propulsion Laboratory that are not logical inclusions elsewhere in the proposal should be described in this section.

7.6 Personnel

The principal investigator is responsible for direct supervision of the work and participates in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included.

Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

7.7 Facilities and Equipment

Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equip-ment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project.

Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for

both research and non-research purposes should be explained.

7.9 Proposed Costs

Proposals should contain cost and technical parts in one volume; do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all manpower data in terms of man-months or fractions of full-time.

Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases (Standard Form 1411 may be used).

Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 18-31 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

7.10 Security

Proposals should not contain security classified material. However, if the proposed research requires access to or may generate security classified information, the submitter will be required to comply with applicable government security regulations.

7.11 Current Support

For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current government-wide guidelines.

Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant government audit agency, inspection agency, and administrative contracting officer, when applicable.

8. Renewal Proposals

Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. It is not necessary that a renewal proposal repeat all of the information that was in the original proposal upon which the current support was based. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which extended support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

NASA reserves the right to renew an effort either through amendment of an existing contract/grant or by a new award.

9. Length

Unless otherwise specified in the NRA, every effort should be made to keep proposals as brief as possible, concentrating on substantive material essential for a complete understanding of the project. Experience shows that few proposals need to exceed 15-20 pages. Any necessary detailed information, such as reprints, should be included as attachments rather than in the main body of the proposal. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments; their availability may be mentioned in the proposal.

10. Joint Proposals

Some projects involve joint efforts among individuals in different organizations or mutual efforts of more than one organization. Where multiple organizations are involved, the proposal may be submitted by only one of them. In this event, it should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

Where a project of a cooperative nature with NASA is contemplated, the proposal should describe the contributions expected from any participating NASA investigator and Agency facilities or equipment which may be required. However, the proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which purport to specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an Agency commitment.

11. Late Proposals

A proposal or modification thereto received after the date or dates specified in an NRA may still be considered if the selecting official deems it to offer NASA a significant technical advantage or cost reduction.

12. Withdrawal

Proposals may be withdrawn by the proposer at any time. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

13. Evaluation Factors

Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

a. Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.
b. Evaluation of its intrinsic merit includes the consideration of the following factors, none of which is more important than any other:
c. Evaluation of the cost of a proposed effort includes the consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

(1) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.
(2) The offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.
(3) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel who are critical in achieving the proposal objectives.
(4) Overall standing among similar proposals available for evaluation and/or evaluation against the known state-of-the-art.

14. Evaluation Techniques

Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases, however, proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house where NASA has particular competence; others are evaluated by a combination of in-house people and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. Regardless of the technique, the final decisions are always made by a designated NASA selecting official. A proposal which is scientifically and programmatically meritorious, but which is not selected for award during its initial review under the NRA, may be included in subsequent reviews unless the proposer requests otherwise.

15. Selection For Award

When a proposal is not selected for award, and the proposer has indicated that the proposal is not to be held over for subsequent reviews, the proposer will be notified that the proposal was not selected for award. NASA will notify the proposer and explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will manage a debriefing.

When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation with fee submitter. Formal RFP's are not used to obtain additional information on a proposal selected under the NRA process. However, the contracting officer may request certain business data and may forward a model contract and other information which will be of use during the contract negotiation.

16. Cancellation Of NRA

NASA reserves the right to make no awards under this NRA and, in the absence of program funding or for any other reason, to cancel this NRA by having a notice published in the Commerce Business Daily. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation. Cancellation may be followed by issuance and synopsis of a revised NRA, since amendment of an NRA is normally not permitted.

Amendatory Guidance to Guidelines Contained in Appendix B

Applicable to NRA 96-OEOP-1

1. Evaluation

General guidelines for proposal preparation are given in Appendix B. However, certain sections of the specific evaluation criteria listed in Appendix B must be modified to be appropriate to the intent of this program. For convenience, the review criteria to be considered in force are listed here, even though some of those remain unchanged from those in Appendix B.

1.1 Evaluation Factors

Proposals will be evaluated on the six criteria listed below. They are listed in descending order of importance (e.g., Technical Soundness is slightly more important than Performance Competence).

a. *Technical Soundness.* Quality and approach of the proposed research, and its relevance to NASA's objectives, overall project design, and thoroughness of research, evaluation and transition plans.
b. *Performance Competence.* Qualifications of faculty principal investigator. Evidence of the researcher's skills, experience, and past accomplishments, and plan for transition to NASA's mainstream research program.
c. *Growth Potential. Degree* to which the proposed research will meet NASA's objective to develop a pool of socially and economically disadvantaged and disabled bachelors and graduate degree recipients, who are U.S. citizens, with research experience in NASA-related fields. Feasibility of proposed plan to track students involved in this research project through completion of their degree.
d. *University Commitment.* Evidence of adequacy of institutional resources available and university long-term commitment of resources, staffing, computer, equipment, and facilities.
e. *Degrees.* Degree awards to underrepresented minorities and disabled students. Provide the total number of bachelor, master, and Ph.D. degrees awarded and the total number and percent of bachelor, master, and Ph.D. degrees awarded to underrepresented minorities and disabled students from the school submitting the research proposal.
f. *Cost.* Appropriateness of the budget, including reasonableness of proposed cost and cost elements, cost-sharing, and the relationship of the proposed cost to available funds.

ADDITIONAL SOURCES OF INFORMATION

1. Information Sources

Additional information regarding the NASA FAR Program can be obtained from the following sources:

1.1 NASA Headquarters

Minority University Research and Education Division
Ms. Deborah Russell
NASA Headquarters
Code EU
Washington, DC 20546-0001
Telephone: (202) 358-0935
E-mail: drussell@oeop.hq.nasa.gov
Fax: (202) 358-3745

1.2 MURED Contacts at NASA Installations and JPL

Installation	NASA Contact	Telephone Number Fax Number
Ames Research Center Mail Code 223-3 Moffett Field, CA 94035	Mr. Aaron Hatch	(415) 604-0790 Fax: (415) 604-3869
Dryden Flight Research Center P.O. Box 273 Edwards, CA 93523	Ms. Erma Cox	(805) 258-3033 Fax: (805) 258-3567
Goddard Space Flight Center Mail Code 160 Greenbelt, MD 20771	Dr. Gerald Soffen	(301) 286-9690 Fax: (301) 286-1610
Jet Propulsion Laboratory Mail Code 183-900 4800 Oak Grove Drive Pasadena, CA 91109	Mr. Alfred Paiz	(818) 354-3014 Fax: (818) 393-4977
Johnson Space Center Mail Code AP2 Houston, TX 77058	Dr. Joseph D. Atkinson	(713) 483-4831 Fax: (713) 483-4876
Kennedy Space Center Mail Code HM-CIC Kennedy Space Center, FL 32899	Mr. Gregg Buckingham	(407) 867-2512 Fax: (407) 867-2454

Installation	NASA Contact	Telephone Number Fax Number
Langley Research Center Mail Code 400 Hampton, VA 23665	Dr. Samuel E. Massenberg	(804) 864-5800 Fax: (804) 864-6521
Lewis Research Center Mail Stop 0100 21000 Brookpark Road Cleveland, OH 44135	Dr. Julian Earls (for HBCU's)	(216) 433-3014 Fax: (216) 433-5749
Lewis Research Center Mail Stop 3-16 21000 Brookpark Road Cleveland, OH 44135	Mr. Robert Lawrence (for OMU's)	(216) 433-2921 Fax: (216) 433-3344
Marshall Space Flight Center Mail Code CE01 MSFC, AL 35812	Mr. Willie Love	(205) 544-0088 Fax: (205) 544-2411
Stennis Space Center Mail Code MA00 Stennis Space Center, MS 39529-7499	Dr. Armond Joyce	(601) 688-3830 Fax: (601) 688-7499

Required Forms

National Aeronautics and Space Administration
Office of Equal Opportunity Programs (OEOP)
Minority University Research and Education Division (MURED)

Proposal Cover Page

Faculty Awards for Research (FAR) Program

[This Box for NASA Use Only]

Proposal Number _____ **Date** _____ **Received** _____

Award Number _____ **Period of Award** _____

_____
Name of Submitting Institution

_____
Proposal Title

Principal Investigator	Authorized Institutional Official
Name	**Name**
Title	**Title**
Department	**Department**
Mailing Address	**Mailing Address**
Telephone Number	**Telephone Number**
Fax Number	**Fax Number**
e-mail Address	**e-mail Address**
X _____ **Principal Investigator Signature**	X _____ **Authorized Institutional Official Signature**
Date	**Date**

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NASA RESEARCH ANNOUNCEMENT - FACULTY AWARDS FOR RESEARCH

National Aeronautics and Space Administration
Office of Equal Opportunity Programs (OEOP)
Minority University Research and Education Division (MURED)

Certification of Institution and Principal Investigator Eligibility

Faculty Awards for Research (FAR) Program

Submit only ONE copy of this form with the original proposal. Do not include this form with any of the other copies, as this may compromise the confidentiality of the information. Completion of this form is required.

I. Institutional Eligibility Certification

1. Institution Name _____

2. Proposal Title _____

_____

3. Name at least one graduate degree offered by the institution in mathematics, science or engineering. Identify highest degree offered (e.g. MS, or Ph.D)

Major _____ Highest Degree _____

Major _____ Highest Degree _____

Major _____ Highest Degree _____

4. Check each of the Department of Education FY 1995 certifications held by the institution.

❒ Minority Institution [underrepresented minority group(s) exceed 50% of the total student enrollment]

❒ Designated Hispanic-Serving Institution

❒ Designated Historically Black College or University

Note: Institutional eligibility will be verified by data on enrollments.

II. Principal Investigator Eligibility Certification

1. Last Name _____ First Name _____ Middle Initial ___

2. Verification of employment:

Employed by (institution) _____

_____

School/Department of (specify) _____

_____

Check type of position:

❒ Tenured ❒ Tenured-track ❒ Contractual

3. Is Principal Investigator a recipient of a Ph.D. degree?

❒ Yes ❒ No

If yes, specify area: engineering, mathematics, science _____

_____

_____

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III. Previous NASA Funding

1. List all NASA awards, NASA contracts, NASA consulting from which the proposed PI received funding as PI or Co-I during the past 5 years, including active awards.

1. Award	2. PI orCo-I	3. Title of Award	4. Period (from-to)	5. Amount
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			Total Funding:	

Instructions:

Column 1. Identify whether award was a research grant (R), education grant (E), contract (C), or consulting agreement (A).

Column 2. For each award, indicate whether applicant was PI or Co-I.

Column 3. List title of award.

Column 4. List the period of performance

Column 5. Amount of award. For awards on which the proposed PI was a Co-I, show only that portion of the award which supported the proposed PI's personal research, and attach an explanation of how this was determined. For awards on which the proposed PI was PI, show the total award amount.

Certification Authority.

The person authorized to sign below certifies that the information provided is accurate.

(Authorized Institutional Official)

Typed

Title

Signature

Supplementary Information Report

Faculty Awards for Research (FAR) Program

Submit only ONE copy of this form with the original proposal. Do not include this form with any of the other copies, as this may compromise the confidentiality of the information. Completion of this section is voluntary. Please check the appropriate answers to each question for the Principal Investigator. Any individual not wishing to provide the information should check the box provided.

❒ No, I prefer not to provide this information

1. Gender ❒ Female ❒ Male

2. Which ONE of these categories best describes this person's ethnic/racial status?
(If more than one category applies, use the category that most closely reflects the person's recognition in the community.) Insert check boxes.

❒ American Indian or Alaskan Native
❒ Asian ❒ Black, not of Hispanic Origin
❒ Hispanic ❒ Pacific Islander
❒ White, not of Hispanic Origin

3. Does this person have a disability* which limits a major life activity?

❒ Yes ❒ No

Definitions:

American Indian or Alaskan Native: A person having origins in any of the original peoples of North America, and who maintains cultural identification through tribal affiliation or community recognition.

Asian: A person having origins in any of the original peoples of East Asia, Southeast Asia and the Indian subcontinent. This area includes, for example, China, India, Indonesia, Japan, Korea and Vietnam.

Black, not of Hispanic Origin: A person having origins in any of the black racial groups of Africa.

Hispanic: A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race.

Pacific Islander: A person having origins in any of the original peoples of Hawaii; the U.S. Pacific Territories of Guam, American Samoa, and the Northern Marianas; the U.W. Trust Territory of Palau; the islands of Micronesia and Melanesia; and the Philippines.

White, not of Hispanic Origin: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

*Disabled: A person having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment; or who is regarded as having such impairment.

Why this information is being requested:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity or disability of the nominee. To gather the information needed for this important task, you should submit a single copy of this form. However, submission of the requested information is not mandatory and is not a precondition of award.

Information from this form will be retained by Federal agencies as an integral part of their Privacy Act Systems of Records in accordance with the Privacy Act of 1974. These are confidential files accessible only to appropriate Federal agency personnel and will be treated as confidential to the extent permitted by law. Data submitted will be used in accordance with criteria established by the respective Federal agency for awarding grants for research and education, and in response to Public Law 99-383 and 42 USC 1885c.

CERTIFICATIONS REGARDING LOBBYING; DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS; AND DRUG-FREE WORKPLACE REQUIREMENTS

Applicants should refer to the regulations cited below to determine the certification to which they are required to attest. Applicants should also review the Instructions for certification included in the regulations before completing this form. Signature of this form provides for compliance with certification requirements under 34 CFR Part 82, "New Restrictions on Lobbying," and 34 CFR Part 85, "Government-Wide Debarment and Suspension (Nonprocurement) and Government-Wide Requirements for Drug-Free Workplace (Grants)." The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of Education determines to award the covered transaction, grant, or cooperative agreement.

---

1. LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 34 CFR Part 82, for persons entering into a grant or cooperative agreement over $100,000, as defined at 34 CFR Part 82, Sections 82.105, and 82.110, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the making of any Federal grant, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions;

(c) The undersigned shall require that the language of this certification be included in the award documents for all subaward at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts) and that all subrecipients shall certify and disclose accordingly.

2. DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

As required by Executive Order 12549, Debarment and Suspension, and implemented at 34 CFR Part 85, for prospective participants in primary covered transactions, as defined at 34 CFR Part 85, Sections 85.105 and 85.100 --

A. The applicant certifies that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

3. DRUG-FREE WORKPLACE (GRANTEES OTHER THAN INDIVIDUALS)

As required by the Drug-Free Workplace Act of 1988, and implemented at 34 CFR Part 85, Subpart F, for grantees, as defined at 34 CFR Part 85, Sections 85.605 and 85.610 --

A. The applicant certifies that it will or will continue to provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing an on-going drug-free awareness program to inform employees about--

(1) The dangers of drug abuse in the workplace;
(2) The grantee's policy of maintaining a drug-free workplace;
(3) Any available drug counseling, rehabilitation, and employee assistance programs; and
(4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
((c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will--
(1) Abide by the terms of the statement; and
(2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;
(e) Notifying the agency, in writing, within 10 calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to: Director, Grants and Contracts Service, U.S. Department of Education, 400 Maryland Avenue, S.W.(Room 3124, GSA Regional Office, Building No. 3), Washington, DC 20202-4571. Notice shall include the identification numbers(s) of each affected grant;
(f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted-
(1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.
(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e), and (f).
B. The grantee may insert in the space provided below the sites(s) for the performance of work done in connection with the specific grant:
Place of Performance (Street address, city, county, state, zip code)

_____

_____

Check ( ) if there are workplaces on file that are not identified here.

DRUG-FREE WORKPLACE (grantees who are individuals)
As required by the Drug-Free Workplace Act of 1988, and implemented at 34 CFR Part 85, Subpart F, for grantees, as defined at 34 CFR Part 85, Sections 85.605 and 85.610 --
A. As a condition of the grant, I certify that I will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant; and
B. If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, I will report the conviction, in writing, within 10 calendar days of the conviction, to: Director, Grants and Contracts Service, U.S. Department of Education, 400 Maryland Avenue, S.W. (Room 3124, GSA Regional Office Building No. 3). Washington, DC 20202-4571. Notice shall include the identification number(s) of each affected grant.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above certifications.

_____
NAME OF APPLICANT

_____
PR/AWARD NUMBER AND/OR PROJECT NAME

_____
PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

_____
SIGNATURE DATE

ED 80-0013

Enrollments & Degrees Awarded Academic Year 1994-95

Faculty Awards for Research (FAR) Program

INSTITUTION _____

ENROLLMENTS-AY 1994-95

Total Enrollment	U.S. Citizens No. (%*)	African American No. (%*)	Hispanic No. (%*)	Native American No. (%*)	Pacific Islanders No. (%*)

** % of Total Enrollment of U.S. Citizens. Note in parenthesis next to the total number, the number of individuals with disabilities i.e., 356 (7)*

DEGREES AWARDED-AY 1994-95

Degrees	Total	U.S. Citizens No. (%*)	African American No. (%*)	Hispanics No. (%*)	Native American No. (%*)	Pacific Islanders No. (%*)
Bachelors						
Masters						
Ph.D.'s						

Note in parenthesis next to the total number, the number of individuals with disabilities i.e., 356 (7)

National Aeronautics and Space Administration
Office of Equal Opportunity Programs (OEOP)
Minority University Research and Education Division (MURED)

Proposal Summary Form
NRA 96-OEOP-1

Faculty Awards for Research (FAR) Program

1. Proposal Title _____

2. Principal Investigator's Name, Organization _____

_____

3. Abstract of Proposed Research (250-300 words) _____

4. Strategic Enterprises Addressed by the Proposal. (Check those that apply)

❒ Aeronautics ❒ Human Exploration and Development of Space

❒ Mission to Planet Earth ❒ Space Technology ❒ Scientific Research

5. NASA Installation individual who has expressed specific interest in this proposal (optional)

Name _____

Installation _____

Telephone _____

6. Budget Summary by Federal Government Fiscal Year:

NASA FY	96:10/95-9/96	97: 10/96-9/97	98: 10/97-9/98
Requested NASA Funding:			
Cost-Sharing (if applicable):			
Total Project Resources:			

7. Period of Performance _____

8. Major accomplishments planned by end of period of performance _____

_____

_____

Budget Form

Faculty Awards for Research (FAR) Program

From _____ to _____

		A	NASA USE ONLY B	C
1.	Direct Labor (salaries, wages, and fringe benefits)			
2.	Other Direct Costs			
	a. Subcontracts			
	b. Consultants			
	c. Equipment			
	d. Supplies			
	e. Travel			
	f. Other			
3.	Indirect Costs			
4.	Other Applicable Costs			
5.	Subtotal--Estimated Costs			
6.	Less Proposed Cost Sharing (if any)			
7.	Carryover Funds (if any)			
	a. Anticipated amount			
	b. Amount used to reduce budget			XXXXXXXXX
8.	Total Estimated Costs			
	APPROVED BUDGET	XXXXXXXXX	XXXXXXXXX	

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General Budget Instructions

1. Provide a separate budget form for each year of proposed research and a summary form.
2. Grantee estimated cost should be entered in the first column. Columns two and three are for NASA use only. Column three represents the approved grant budget.
3. Provide in attachments to the budget summary the detailed computations of estimates in each cost category, along with any narrative explanation required to fully explain proposed costs.
4. General-purpose, non-technical equipment is not allowable as a direct cost to NASA grants unless specifically approved by the grant officer.
5. In connection with indirect cost provide the name, address, and telephone number of the Federal agency and official having cognizance over such matters for the institution.

Line-by-Line Instructions

1. Direct Labor (salaries, wages and fringe benefits): Attachments should list number and titles of personnel, amount of time to be devoted to the grant and hourly rates of pay.
2. Total Direct Labor Hours: Show total number of estimated labor hours required to accomplish the task.
3. Other Direct Costs:
   a. Subcontractors - Attachments should describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting this effort.
   b. Consultants - Identify consultants to be used, why they are necessary, time to be spent on the projects and rates of pay (not to exceed the equivalent of the daily rate for GS-18 in Federal service: $429 per day as of January 19, 1992, excluding, expenses and indirect costs.
   c. Equipment - List separately and explain the need for items of equipment exceeding $1,000. Describe the basis for the estimated cost.
   d. Supplies - Provide general categories of needed supplies, the method of acquisition, estimated cost, and the basis for the estimate.
   e. Travel - List proposed trips individually, describe their purpose in relation to the grant, provide dates, destination, and number of travelers where known, and explain how the cost for each was derived.
   f. Other - Enter the total of any other direct costs not covered by 3a through 3e. Attach an itemized list explaining the need for each item and the basis for the estimate.
4. Indirect Costs: Identify indirect cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. If unproved rates are used, explain why and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
5. Other Applicable Costs: Enter the total of any other applicable costs. Attach an itemized list explaining the need for each item and the basis for the estimate.
6. Subtotal — Estimate Costs: Enter the sum of items 1, 3.a, through 3.f, 4, and 5.
7. Less Proposed Cost Sharing (if any): Enter the amount proposed if any. If cost sharing is based on specific cost items, identify each item and amount in attachment.
8. Total Estimate Costs: Enter the total after subtracting item 7 from item 6.

Description of Research Opportunities

AMES Research Center

Aerophysics:
Aerodynamics: applied aerodynamics, advanced aerodynamic concepts, aerodynamic facilities and operations. Computer systems and research: systems integration. Fluid Dynamics: computational aerosciences, computational algorithms and applications, turbulence and transition, modeling and experimental validation, fluid mechanics. Numerical Aerodynamic simulation Systems: applied research, systems development, computational programs.

Aerospace Systems:
Full-Scale Aerodynamics Research: fixed wing aerodynamics; rotorcraft mechanics; National Full-Scale Aerodynamics Complex (NFAC), the worlds largest wind tunnel; data acquisition, systems and research operations. Information Sciences: artificial intelligence, computational systems, spacecraft data systems. Human Factor Research: computational human engineering; full-mission simulation, human interface research, rotorcraft human factors, flight human factors. Flight Systems and Simulation: air traffic control, field systems, flight dynamics and control; simulations experiments, aircraft systems, aircraft guidance and navigation, simulation systems.

Airborne Science and Applications:
Develop instruments and conduct airborne experiments in earth systems science and airborne astronomy utilizing unique high altitude (ER-2) and medium altitude (DC-8, C-130, Learjet) airborne facilities for remote sensing and in-situ earth studies. Analyze and archive of acquired airborne science data. Develop sensors and perform ground-based infrared astronomical observations and data reduction and analysis.

Ecosystem Science and Technology:
Interdisciplinary research which looks at the role of life in modulating the complex cycling of materials and energy throughout the biosphere. Intact ecosystems, with particular emphasis on temperate and tropical forests, are examined by remote sensing from aircraft and spacecraft and by field site visits, with subsequent laboratory and computer analysis of the data gathered.

Flight Research:
Flight test, modification and maintenance of powered-lift aircraft and rotorcraft. Development and evaluation of ground-based flight simulators. Management and operation of aeronautical test range for research aircraft tracking and data analysis.

Space Research:
Life Sciences: gravitational biology, flight equipment engineering, science operations, payload operations. *Earth System Science:* ecosystem science and technology, atmospheric chemistry and dynamics, atmospheric physics. *Space Science:* observational astrophysics, laboratory astrophysics, planetary science, exobiology, star and planet formation, search for other planetary systems, planetary exploration. *Advanced Space Technology:* extra-vehicular life support systems, regenerative life support systems, hypersonics, aerothermodynamics, computational chemistry, thermal protection systems, and facilities, infrared detector development, cryo-optics, systems evaluation and integration. *Space Projects:* centrifuge facility project, gravitational biology project, stratospheric observatory for infrared astronomy project, Discovery project development, unpiloted research aircraft development, advanced mission studies.

Dryden Flight Research Center

Flight Operations:
High speed/performance mission support, shuttle landing support, avionics, flight crew, aircraft life support, operations engineering, aircraft quality inspection, aircraft maintenance and modification, flight data acquisition systems, and mission control.

Research Engineering:
Fluid and flight mechanics, aerostructures, thermostructures, propulsion and performance, flight instrumentation, flight dynamics, flight controls and systems, structural dynamics, thermal and mechanical load control systems, ground test data acquisition systems, and sensor evaluations.

Research Facilities:
Information systems, range systems, flight simulation systems, integrated test systems, systems development, system integration and facilities engineering.

Goddard Space Flight Center

Space Sciences:
High energy astrophysics; X-ray and gamma-ray spectroscopy, cosmic ray physics; solar, stellar, galactic and metagalactic high energy processes; UV, optical, and infrared astronomy; theoretical astrophysics; cosmic background radiation; solar physics; radio galaxies; chemical history of solar system; solar wind; comets; planetary atmospheres, magnetospheres, meteoritic asteroids, radio wave and ion plasma of planetary satellites; galactic, stellar, and planetary infrared spectroscopy; molecular aeronomy; extreme UV spectroscopy, laser spectroscopy interstellar material; planetary electric and magnetic fields.

Earth Sciences:
Earth system sciences integrates the search for understanding of the way the Earth System works including interactions among the atmosphere, hydrosphere, biosphere, and the solid Earth. This involves numerical modeling of the atmosphere, ocean, and terrestrial systems; supporting studies on radiation, vegetation, tropospheric and stratospheric chemistry, ocean surface dynamics, sea ice, oceanic productivity, regional and micro-scale dynamics, cloud convection, cloud modeling and radiation balance, solar radiation studies, geophysics, plate tectonics, geomagnetism, gravity, celestial dynamics, and planetary atmospheres. Tools used to provide observations supporting these studies include remote sensing instrumentation, passive and active instruments including laser and radar altimetry, scatterometry, microwave sensors. Data interpretation methods, data assimilation into models. Field studies, involving in situ sensors, aircraft and satellite sensors.

Engineering Development:
Optical analysis, optical material research and optical metrology equipment development; thermal analysis including two phase heat transfer, contamination effects and contamination transport mechanisms applied to advanced spacecraft and instrument systems for STS and free-flying spacecraft; cryogenic cooling development for space instruments; very large scale integrated circuits using NMOS and CMOS; multi-chip module radiation-hardened processors, high density solid state memories, and fiber optic data networks. advanced electronic and photonic materials and microelectronic device fabrication; ultra-low noise microwave amplifier and mixer design and testing; correlated double sampling of infrared detector array data; advanced sensors and instruments for observation of x-ray, gamma-ray and ultraviolet radiation, images, and spectroscopy; electromechanical subsystem control, interactions, system modeling, and developing control laws for small self-contained instruments; vibration cancellation and isolation; analysis of the dynamics of large structures in orbit, flexible space structures, thermal effects, excitation by mechanisms or spacecraft control system; attitude dynamics and control of spinning/non-spinning flexible spacecraft and, dynamics and precision pointing of instruments from zero

momentum 3 axis controlled spacecraft. Communications & Data Systems Development: Expert systems/neural networks/model-based systems/agent based systems for automated mission operations, resource scheduling, and system and network modeling and fault isolation; distributed systems for payload control and data handling; VLSI and gate array design for real-time telemetry processing; software engineering technology for decentralized development of large scale systems and development of a reusable software base; data management technology for distributed systems and data flow architectures for telemetry processing; human factors technology and rapid prototyping techniques for interactive spacecraft, network, and data system control workstation design.

Computational Sciences and Information Systems:
Simulations and modeling of Earth and space phenomena; high performance computing; global optimization algorithms and applications; simulated analogs; genetic algorithms; neural networks; intelligent data management systems; mass data storage systems, access, and retrieval; scientific visualization and animation; voice recognition data compression, and on-board high performance data recorders. Research Opportunities at Wallops Flight Facility Physical oceanography, laser remote sensing applications, atmospheric chemistry, remote sensing of atmospheric ozone, development of remote sensors, thin film material research, balloon membrane structural analysis, launch vehicle aero-ballistics, re-entry, aero-thermal analysis, development of improved attitude control system(s), network and data systems control, thermodynamic modeling of large balloon structures.

Jet Propulsion Laboratory

Systems:
Systems analysis; policy analysis and operations research; design of space missions; spacecraft system design, integration; assembly, test, and launch operations; navigation; spacecraft sequence design including robotics and artificial intelligence applications; mission operations systems; distributed real time information systems.

Earth and Space Sciences:
Emphasis on remote sensing along with extensive efforts in data analysis and theoretical modeling, field measurements and laboratory research in related disciplines. Fields of interest are planetary atmospheres, planetary geology, planetary and interstellar astronomy, astrophysics, relativity and cosmology, interplanetary space physics, comet and asteroid studies, Earth atmosphere, atmospheric chemistry, global weather and climate, oceanography, geosciences, air-sea interaction, and air-land interaction.

Telecommunications Science and Engineering:
Emphasis on deep space and Earth satellite communications, radiometric tracking and active remote sensing along with related science, technology, and engineering. Areas of current interest include: spacecraft communications systems, highly stable microwave transponders, low noise amplifiers, efficient antennas, source and channel coding, noise processes, signal processing, communication networks, ultra-precision frequency standard systems, custom VLSI chips for communications, optical space communication systems, satellite-based mobile communication systems, high power earth-based radar, spaceborne synthetic aperture radar, altimeters, meteorological radars, scatterometers, radar radiometrics, VLBI and GPS-based systems for navigation and tracking, geodynamics science and instrumentation, radio and optical interferometry.

Avionic Systems and Technology:
Advanced microelectronics including sensors, micromagnetic and superconducting devices, and microelectronic materials; in-situ microinstruments; analog processing devices, fuzzy logic, and neural networks; guidance and control analysis for advanced spacecraft including special topics in formation flight and tethered systems; sensor, actuator, and control development for spacecraft, amicrospacecraft, and space structures; space interferometer technology; robotics, telerobotics, autonomous vehicles, and microrovers; telepresence and virtual reality; machine vision, photonics, including optical processing

and electro-optics; machine intelligence and autonomous intelligent spacecraft, ground system, and mission operations technology; energy conversion, storage and management, including fuel cells, batteries, solar arrays, and thermal-to-electric converters, for spacecraft and terrestrial power systems; integrated microavionics technology and applications including concurrent, distributed processing, integrated power electronics, and advanced packaging; spacecraft data system technology including computer architecture, flight computers, data storage, and software.

Mechanical Systems Engineering and Research:
Active cooling of sensors, vibrational isolation of substructures, precision deployable space structures, precision inflatable structures, opto-electronic materials, dimensionally stable structures, smart structures and materials, active optics devices, electric propulsion, advanced chemical propulsion, cold electronics, advanced electronic packaging, low temperature physics, advanced chemical systems, miniaturized spacecraft components, advanced instrumentation, environmental simulation.

Observational Systems:
Development of instrumentation systems employing X-ray, ultraviolet, visible and infrared imaging; infrared and visible spectroscopy; passive microwave radiometry; and analytical techniques. Development of calibration science technology to enable quantitative remote sensing. Technology development and characterization of advanced sensors and focal plane arrays. Development of optical systems, interferometry, electro-optical systems, and optics technology. Development of science data processing systems including algorithms and systems architectures, image processing and science data analysis and visualization. Development of science data management systems and analyzing systems.

Information Systems Development and Operations:
Development, planning and operations related to ground-based information systems for spacecraft missions. Research areas include: advanced automation for spacecraft diagnosis; simulation and graphics for knowledge fusion, data understanding, and training; high-rate, high-capacity information systems; software productivity and reliability; intelligent access to large, interactive hypermedia databases; high-performance computing and networking; numerical analysis and computational software libraries; and low-cost mission operations.

Reliability Engineering:
Electrical interactions and environmental modeling, radiation caused electrostatic discharge, single event upsets, microelectronics parts reliability and packaging, dielectric breakdown, plasma models, high energy trapped radiation, cosmic ray models, planetary magnetospheres, high voltage interactions, reliability predictions, launch dynamic environment estimates and analysis, dynamic modeling and testing, thermal environment estimates and analysis, thermal modeling and testing.

Software Assurance:
General software engineering, software product assurance, software reliability, software metrics, formal methods, formal inspections, software safety, object oriented development methods, requirement analyses, human-computer interfaces, casual analyses and command assurance.

Johnson Space Center

Engineering Directorate

Crew and Thermal Systems Division:
Research and technology development in the areas of biological and physical/chemical regenerative life support systems and active thermal control systems for crewed spacecraft and surface bases; extravehicular individual life support systems; space suit systems, and protective system concepts for dust exclusion from extravehicular system hardware components.

Tracking and Communications Division:
Design and analysis of space communication and tracking systems. Topics of interest include: infrared, laser/optical millimeter wave, microstrip patch antennas, multibeam arrays, multiaccess, packetization, interference tolerance, channel coding, video compression, secure data, voice control, automated control and monitoring, and digital and Fourier optics vision.

Navigation, Control, and Aeronautics:
Design, development, integration, and testing of guidance, navigation, and control hardware and software systems for atmospheric and orbital flight; aerosciences engineering in the disciplines of flight dynamics, computational fluid dynamics, aerodynamics, and aerothermodynamics; application of Total Quality Management Tools to projects.

Flight Data Systems:
Study of flight data systems hardware and software which provides spacecraft computation and information processing, onboard check-out, instrumentation, data storage, and displays and controls. Includes applied technology studies for spacecraft data systems, instrumentation, signal conditioning, data recording, and advanced displays and controls.

Propulsion and Power:
Study of propellant chemistry and physics of combustion venting; fluid system leakage detection; cryocoolers for long-term storage; high temperature rocket combustion chamber materials; propulsion/fluid system health monitoring; electric motors and controllers; zero/low gravity fluid management for Earth storable and cryogenic fluids; chemical reaction kinetics of pyro initiator explosions; evaluation of fuel cell polymer and intercalation-type electrodes; development of software system designs for distribution, control, and management of electrical power for space systems.

Automation and Robotics:
The study of the application of Artificial Intelligence (AI) and advanced automation technologies to the areas of: system and subsystem monitoring, control and diagnosis; automated assistance for systems operations; process planning and scheduling; advanced systems analysis and control; computer-aided engineering; concurrent engineering and intelligent integration of information; massively parallel and distributed computer processing; automated knowledge acquisition and machine learning; object-oriented databases and data mining; graph theory and knowledge representation; human-computer interaction; engineering methods for intelligent systems; teleoperator, telerobotic, and autonomous robotics control system development; robotic sensing, perception, and world model updating; real-time simulation of manipulators; engineering and integration of manipulators and end-effectors into laboratory robots.

Structures and Mechanics:
Study of microcracking of composite materials; study of spacecraft re-entry thermal protection and on-orbit thermal control techniques modal, vibration, and acoustic testing; and methods for micro-g isolation of on-orbit experiments, advanced methods for use in structural response analysis, and advanced computational computer-aided engineering graphics techniques for structural and thermal analysis.

Systems Engineering:
Research and development in the area of flight mechanics: conceptual design and analysis of evolutionary and future systems for transportation; Earth orbit activities.

Information Systems Directorate

Advanced Information Systems Technology:
Opportunities exist for developing and evaluating advanced information systems technology in support of NASA institutional and mission operations. Current areas include research into heterogeneous digital

libraries, virtual reality technologies, general purpose intelligent training systems, expert assistants, neural networks for machine learning, applications of pattern recognition and signal processing to system monitoring and process control, software development tools and methods, network technology, genetic algorithms, distributed computing technology, and knowledge/process capture technology.

Safety, Reliability, and Quality Assurance Office

Develop strategies for expanding the current methodologies in risk assessment. Investigation, assessment, evaluation and initial feasibility development of automated failure tolerance analysis program, FMEA programs, fault tree generation programs, and system safety analysis programs. Develop software product assurance methodologies for very large scale systems, expert systems and certified intelligence systems, including verification and compliance with product assurance requirements. Develop on-orbit systems maintainability technology such as calibration and pressure systems recertification. Develop application of existing nondestructive evaluation (NDE) technology for on-orbit systems including leak detection, composite materials, stress distribution, and surface impact detection. Develop technology and methodology for early detection of system failures, contamination, fires, and leaks.

Space and Life Sciences Directorate

Life Sciences Project Division:

Investigation, assessment, evaluation and initial feasibility development of biomedical instrumentation devices, systems, and supporting equipment for human experiments. Development of flight experiment hardware and supporting ground test equipment including definition, systems engineering and analysis, hardware fabrication and acceptance testing. Systems include sensing instruments, control, and data in support of in-flight biomedical monitoring of human status and performance. Areas of interest include flight experiment microcomputers; non-invasive physiological monitoring, respiratory gas analysis via mass spectrometry; data storage and recording; biomedical telemetry; auto test and checkout systems; ground support facility development and specialized support equipment.

Flight Crew Support Division:

Human-machine interface requirements definition, systems engineering, analyses and integration for development and operation of human-systems for spaceflight and planetary habitats. Areas of interest include Advanced Food Technology, flight crew equipment development and provisioning including clothing, restraints, mobility aids, personal hygiene, emergency survival techniques, housekeeping in reduced and microgravity, long mission systems development for clothes washing, personal hygiene, modified integrated logistics support techniques for small critical systems, advanced technologies for microgravity and 1-g human-machine interfaces; computerized dynamic, anthropometrically accurate, human-modeling; control of remote operations/human interfaces to automated systems; human-computer interaction research; system information management; habitability subsystems and protocols; biomechanics data collection and human modeling; advanced ADP technologies and applications; and high resolution digital image acquisition/storage/ transmission/reproduction.

Medical Sciences Division:

Evaluation of bone demineralization, muscle atrophy, and cardiovascular deconditioning resulting from space flight; astronaut radiological health assessment; prevention of decompression sickness following pressure changes, biotechnology and cell culture in space; hormonal regulation of fluid and electrolyte balance; pharmacokinetics in space; nutritional biochemistry; muscle cell physiology; toxicological assessment of spacecraft environment; microbiological capability in space; physiological correlates of space adaption syndrome; clinical characterization of space motion sickness (SMS); vestibulomotor and vestibulocular mechanism in SMS; behavioral, physiological and pharmacological countermeasures; development of capabilities for in-flight health care, physical exercise, and spacecraft environmental monitoring.

Earth Science and Solar System Exploration Division:
Fundamental research on the composition, origin, and evolution of terrestrial planets, meteorites, and interplanetary dust through chemical, mineralogical, and isotopic analysis of extraterrestrial materials utilizing state-of-the-art analytical instrumentation and through laboratory simulation of natural melting and impact processes using high-pressure, high-temperature furnaces and hypervelocity impact facility. Cooperative studies of energy expenditures in humans using mass spectrometers. Lunar base science and lunar and Mars resource utilization studies. Definition of future human planetary missions. Applied research into the characteristics of the near-Earth space environment, including measuring and modeling the distribution, rate of growth, hazards, and mitigation of debris in Earth orbit; hydrocode modeling of debris impact; experimental and hydrocode modeling studies of hypervelocity impacts onto spacecraft components; analysis of impacts on space-exposed surfaces; and measurement and modeling of the space radiation environment. Engineering analysis of photography and television of Shuttle and Space Station. Study of environmental, geological, oceanographic, and meteorlogical processes as revealed in photography from Shuttle.

Space Station Program Office

Vehicle Office:
EPIMS (EEE Parts Information Management System), which is a NASA-wide parts management system, was selected by the ISS (International Space Station) PCB (Parts Control Board) AIT (Analysis and Integration Team) as our baseline platform because it was already operational and eliminated the need to create our own database. EPIMS is currently capable of accepting various formats; however, the contractor data and other historical data from the Space Station Freedom Program must be translated and loaded on our local EPIMS server for the GSFC administrator to bulk load the data into the EPIMS database. In addition, electronic interfaces between EPIMS, PALS (Program Automated Library System) and the VMDB (Vehicle Master Database) need to be established so the subsystem parts list can be loaded into the VMDB and EEE parts documents, such that the Space Station quality specifications can be assessed by the International Partners and contractors. The primary task will be to build/establish more effective electronic processes for transferring contractor and International Partner data into our baseline database systems (i.e., EPIMS, PALS, RTM [Requirements Traceability Manager] system, IMDS [Item Management Database System], and the VMDB).

Kennedy Space Center

Artificial Intelligence/Expert Systems:
The development of knowledge based systems for a variety of ground processing and management functions. Specific interest exists in real-time control and monitoring, automated test procedure development, imbedded diagnostics, fault isolation, and management planning and scheduling applications.

Robotics:
The application of current and advanced robotics technology to time critical, hazardous or repetitive labor intensive operations. Specific interest exists in high-speed vision, precise positioning, force-torque tracking, counter balancing, adaptive control software, and redundancy. Application under study or development include: remotely controlled umbilicals, inspection and re-waterproofing of orbiter tiles, inspection of orbiter radiator panels, inspection of payloads and cleaning of payload canisters.

Computer Science:
Research and development includes real-time systems for control and monitoring of complex checkout and launch procedures. Distributed data bases and computer networking techniques and various microprocessor applications are in work and human-computer interface techniques are under investigation. Major efforts include the development processing systems specifically designed for use at KSC.

Communications/Fiber Optics:
Continued work with multi and single mode optical fibers exists as well as development activities in optical multiplexing, switching, repeaters, and various fiber optic instrumentation techniques. Applications for research also include high speed baseband and broadband communications in the integratrd networking environment and high reliability/redundant dedicated circuits.

Communications/Networks:
Research, development, and evaluation of leading edge network architectures, network operating systems, and network protocols. These would be for local area networks(LAN), metropolitan area networks(MAN), wide area networks(WAN) and the internet. Focus study or analysis would include reduction of implementation and operating costs of existing systems, system expansions, and new systems. This is to be accomplished through the application of new technology, new techniques and consolidation of systems.

Instrumentation and Hazardous Gas Monitoring:
Numerous advanced technology projects include hydrazine sensing, mass spectrometry contamination monitors, personnel dosimeters, gas monitors and warning equipment for trace levels of several toxic elements. Other instrumentation projects involve level and flow measurement of cryogenic propellants, new transducers, and state of the art fire detectors.

Fluids:
Tasks underway involve cryogenic vacuum jacketed storage, perlite compaction, hypergol vapor dispersion down draft elimination, low cost cryogenic transfer pipe lines, slush hydrogen transfer pipe lines, magnetic refrigeration for air conditioning, two phase fluid flow meters, self contained atmospheric protection ensemble breathing air management systems, hypergol discharge elimination and hypergol vapor scrubber improvement.

Computer Aided Engineering:
Development of analytical and graphic techniques to improve engineering tasks associated with modeling and reporting results from analysis and laboratory tests dealing with dynamic loads, cryogenic two phase flow and heat transfer, and structural, mechanical and electronic systems.

Atmospheric Science:
KSC is interested in predicting severe weather and thunderstorms. Instrumentation is in place and under development to track thunderstorms based on electromagnetic and electrostatic characteristics. Opportunities exist in studying the physics of lightning processes, in characterization of electromagnetic emission associated with lightning and in the development and implementation of improved lightning protection techniques. In addition, opportunities also exist in development of real-time, automated techniques for quality control processing of data collected by wind prodiling radars and hardware to advance wing profiling techniques.

Life Sciences:
Continuation of project to demonstrate the feasibility of using closed, controlled ecological systems to regenerate critical elements of human life support. Initial tasks employ a refurbished hypobaric chamber to verify varieties of plants in communities for the production of edible biomass and respirable oxygen, and to recycle water, human waste fluids, solids and metabolic gases. Application of AI/Expert systems, robotics and instrumentation to this project is appropriate. Other allied research tasks deal with general contamination control of habitable space structure; the influence that microgravity may have on plant growth, metabolism, and production; the preservation of human health for long duration missions.

Material Science:
A number of tasks are underway investigating corrosion preventative coatings to include electrically conducting polymers, accelerated corrosion test techniques, thermal protective coatings, material

ignitability in high pressure oxygen, and Cholorofluorocarbon (CFC) replacement chemicals and mechanical cleaning techniques.

Industrial/Business Management:
Development models and measures for the cost effective application of information technology to shuttle processing.

Industrial Engineering:
The development of industrial engineering tools for supporting efforts to improve Shuttle processing efficiency and effectiveness. Specific areas of interest include: human factors engineering, work measurement and methods analysis, process modeling and analysis (including simulation, probabilistic risk analysis and decision analysis), and benchmarking.

Systems Safety:
Perform research in the identification and control of hazards, probabilistic risk assessment, fault tree analysis and applications, interactive hazard information tracking and closure systems, reliability engineering.

Quality Engineering:
Perform research in the application of statistical process control, methods and analysis, automated assessment techniques and evaluation of inspection methods.

Flight Hardware Evaluation:
Activities would involve verification testing of space flight hardware in support of life sciences research in space. The hardware is to be evaluated as to providing an appropriate environment for the experimental organism within the mass, size and power constraints of a Space Shuttle middeck locker. The tasks involve ground-based biological verification of the appropriateness of the hardware as a research tool.

Life Sciences Educational Programs:
To track participation in these programs, a database will need to be developed to maintain a record of persons involved, activities and responses to the specific programs in order to establish and track the value of these programs. The database must be user friendly and provide the ability of sorting, compiling and printing items such as mailing labels. There also exists a need to develop the means of evaluating the efficacy of these educational programs. This will include the development of instruments such as surveys, questionnaires, interview guidelines and tests. The instruments must also be pilot tested and evaluated as to their content validity and situational usefulness. Other tasks would be to develop curriculum enhancements to the current programs and improved means for coordinating and implementing existing programs.

Langley Research Center

Atmospheric Sciences Program:
Apply Langleys capabilities to expand the scientific understanding of the Earths stratosphere and troposphere and develop the ability to assess potential threats to the atmosphere.

Automation and Robotics:
Manipulate dynamics and control, end effector system, operator machine interfaces, machine intelligence, machine vision and artificial intelligence.

Climate Research Program:
Theoretical, laboratory, and field investigations of the chemical and radiative properties of natural and human-made aerosols and assessment of their impact on regional and global climate. Remote and in situ observations of cloud properties and radiation balance components and theoretical studies.

Computer Science:
Concurrent processing, highly reliable computing, information and data base management, and software engineering.

Controls and Guidance:
Fault tolerant systems, aerospace vehicle dynamics and control, crew station technology, applied control concepts.

Electromagnetic Systems:
Electromagnetic analysis methods, far-field and near-field antenna measurements and analysis, High Intensity Radiated Fields, compact range applications, and aircraft and spacecraft antenna systems.

Electronics and Information Systems:
Microwave sensing technology, laser sensing technology, optical data processing, magnetic bubble memory technology, very high speed information processing.

Engineering Lab Team:
Physical and chemical analytical testing services needed for the operation of facilities at LaRC. Development of analytical instrumentation that will advance services at LaRC or will advance technology in aeronautics and space projects. Current projects include instrumentation for environmental control, X-ray fluorescence spectroscopy for wear metal, agricultural and geological analysis, flow field and temperature visualization for wind tunnel models and high temperature superconductive materials for magnetic levitation.

Facility Assurance:
Systems safety and risk management techniques applied to unique wind tunnel facilities and operations.

Facility Engineering:
Engineering and design of research facilities and equipment for aeronautical and space research, including wind-tunnel structures and systems, test sections, model support, environmental chambers, heaters, coolers, mechanical drives, electrical drive machinery and electrical distribution systems.

Flight Deck System:
Flight management technology, systems management concepts, flight deck automation/integration, and aviation safety.

Fluid Physics:
Subsonic aerodynamics, transonic aerodynamics, high speed aerodynamics, computational fluid dynamics, turbulent drag and noise reduction, airfoil aerodynamics, advanced test instrumentation, full scale Reynolds number test technology, applied mathematics and computer science.

General Aviation:
Aerodynamics, crash dynamics, integrated design and manufacturing, propeller noise reduction, avionics, single pilot IFR systems, and system interaction.

High Speed Aircraft:
Flight dynamics, advanced military aircraft and missiles, high speed transportation, supersonic laminar flow, and single-stage-to-orbit vehicles.

Hypersonic Fluid Physics:
Launch vehicle and spacecraft aerothermodynamics and configuration technology; and aerodynamic and aerothermodynamic flight data analysis.

Low-Speed Aircraft:
Rotorcraft structures, vibrations, aeroelasticity and acoustics, natural laminar flow.

Materials and Structures:
Structural composites and adhesives, materials for advanced aircraft and spacecraft structures, loads, aeroelasticity and structural dynamics, high temperature aerospace structures and thermal protection system materials, advanced space structures, design methods, and space vehicle dynamics, nondestructive evaluation, computational structural mechanics, and fatigue and fracture mechanics.

Propulsion:
Noise research, propulsion integration, hypersonic airbreathing propulsion research, advance turboprops.

Spacecraft Systems and Transportation Systems Technology:
Space structures systems technology, File II flight experiment, semiconductor materials growth in low G environment, computer-aided design, future space vehicle concept development, operations research, integrated systems design, and advanced launch systems.

Systems Engineering:
Mathematical modeling, optimization, parametric studies and cost estimation of various engineering systems.

System Genopersistation Technology:
Develop technology for the genopersistation of systems, that is, technology for accomplishing the functions: conceptually design, develop, test and evaluate, produce, deploy, operate, support, evolve, retire, and manage. Emphasis is to be placed on how NASA and its support community can accomplish these functions faster, better, and with less resource utilization.

Transport Aircraft:
Wake vortex minimization, laminar flow control, high Reynolds number research, configuration aerodynamics, advanced guidance and control, flight management research, noise reduction, and air traffic management.

Lewis Research Center

Aeronautical Propulsion:
Rotorcraft, subsonic, supersonic, and hypersonic propulsion systems and components; aerodynamics and acoustics of turbomachinery; aerodynamics of inlets and nozzles; fundamentals of internal combustion; small engine propulsion technology; aircraft icing.

Propulsion Systems Analysis:
Propulsion system and aircraft modeling, integration analysis, novel concepts, mission studies, configuration studies, and environmental/economic assessments.

Computer Science:
Numerical analyses including nonlinear regression, acceleration of series or sequences of scalars and vectors, symbolic manipulation, modularized algorithms, client/server architectures, graphical user interface design and development.

Data Management:
Acquisition of experimental data, data base structure and searching, management information systems.

Instrumentation and Control:
Advanced instrumentation for propulsion research including thin-film sensors and remote-sensing optical based systems, advanced propulsion and flight controls emphasizing integrated and fault tolerant controls and fiber optic based control systems, high temperature integrated electronics and sensors based on SiC technology.

Internal Fluid Mechanics and Heat Transfer:
Advanced numerical methods, multiblock grid and zonal approaches, 3-D geometry and mesh-generation techniques, prediction of 3-D turbulent flow fields, application of advanced computer concepts and expert systems, fluid mechanics of inlets and nozzles, aerothermodynamics of combustors and augmentors, fan and compressor aerodynamics, flow and heat transfer in turbines, unsteady aerodynamics.

Materials:
Metallic materials and advanced processing methods, ceramic and ceramic matrix composites, polymer and metal matrix composites, fundamental studies in tribology.

Microgravity Experiments:
Combustion, materials processing, crystal growth, fluid physics, theoretical modeling.

Space Communication:
Microwave amplifiers, solid-state devices, circuit technology, RF systems, digital systems, advanced antenna technology.

Space Power:
Photovoltaics, electrochemical energy storage, solar dynamic power systems, power electronics devices, electrophysics, power distribution systems, environmental interactions.

Space Propulsion:
Primary and auxiliary chemical rockets; ion, resistojet and arcjet electric propulsion; rocket engine health management, expendable launch vehicle upgrades.

Space Systems Engineering:
Space Station power system, advanced communication satellite (ACTS).

Structures:
Analysis and design methodology of metallic and composite engine structures, advanced structural mechanics, nondestructive evaluation, fatigue, fracture and life prediction, aeroelasticity and structural dynamics, rotor dynamics.

Marshall Space Flight Center

Space Sciences:
Gamma ray, x-ray astronomy; cosmic ray, low temperature, solar, atomic, magnetospheric, and space plasma physics; aeronomy; superconductivity.

Earth Science:
Storm physics; geophysical fluid dynamics; atmospheric processes, dynamics and composition; remote sensing including laser Doppler and visible/infrared devices.

Computer Science:
Supercomputer systems optimization; distributed data management, Management Information Systems (MIS).

Microgravity Science:
Containerless processing, crystal growth, solidification phenomena, separation techniques, fluid modeling, protein crystal growth, optical techniques, solid-state structure and property characterization.

Materials and Processes:
Engineering physics, advanced NDE techniques, atomic oxygen effects, turbopump bearings, space lubricants, metallic materials, non-metallic materials, composites, propellants, processes engineering, robotics welding, welding process, vacuum plasma spray technology.

Structures:
Structural design optimization of isotropic and anisotropic space structures and elements, orbital (debris/meteoroid) protection systems, stress analyses, fracture mechanics, fatigue, durability, structural test methods.

Dynamics:
Rotordynamics, pointing and vehicular control systems design, large flexible space structures dynamics, vibroacoustics response, loads analyses, design criteria and verification methods, computational fluid dynamics, rarefied gas dynamics, fluid-elastic instabilities.

Propulsion:
Propulsion concepts for advanced space exploration, propulsion systems analysis, zero and low gravity fluid management, solid rocket motor technology development, hybrid propulsion technology development, combustion stability analysis, health management, reliability, turbo-machinery performance, cryogenic bearing design, engine ignition and transient analysis, combustion analysis, spray combustion experiments, combustion diagnostics, automated control systems, rocket engine testing, and digital/analog data acquisition systems.

Thermal Control and Life Support:
Closed loop life support analysis/integration/testing, heat pipes/two phase flow analysis and modeling, avionics cooling, low temperature control/refrigeration development, passive thermal protection concepts and thermal vacuum testing techniques.

Information and Electronic Systems/Avionics:
Electrical systems, electrical power systems and components, solar power, high-rate and high-density data acquisition, audio and video systems, radio frequency and laser communication, lidar, antenna systems, flight computers and related ground support equipment, flight electronic packaging, life-cycle software engineering, math models, system and subsystem flight simulations, software development and management, fault tolerant logic systems, electronic device failure analysis techniques, optical instruments and systems, optical metrology, optical fabrication, and photographic processes.

Automation and Robotics:
Automation techniques (all Avionics disciplines), knowledge-based AI/Expert Systems development and implementation, robotics, telerobotics, and robotics system simulations.

Systems Analysis and Integration:
Systems engineering, systems analysis, systems design, integration/verification, orbital mechanics, optimization, trajectory optimization, mission design, guidance schemes, navigation methods, EMC/EMI analyses and modeling, Space Station support for lunar base/Mars mission, and configuration management techniques.

Systems Safety Engineering:
Hazard identification and control, probabilistic risk assessment, fault tree analysis, interactive hazard information tracking. Automated assessment techniques, reliability engineering, statistical modeling,

failure mode analysis.

Quality Engineering:
Application of quality function deployment, design of experiments for process characterization, program quality cost studies, application of statistical process control methods

Testing and Experimentation:
Non-destructive evaluation of structures under dynamic loads, holographic and optical techniques, experimental astrophysics, vacuum system design.

Advanced Mission Studies:
Conceptual design of advanced launch and orbital vehicles, large optical systems, laser power beaming, geostationary facilities, crewed lunar and Mars missions and scientific spacecraft.

Mission Operations:
Resource analysis, operations planning and integration, flight systems operations, data management, crew procedures, human/systems integration, mission design, ground control systems design, development, and operation, communications systems, training systems design, development and operation, flight and ground crew training, human-systems development and development of analytical tools such as virtual reality.

Stennis Space Center

Propulsion Systems Testing Techniques:
A flexible, dynamic fluid flow simulation and structural modeling graphic interface research tool is desirable for ground test programs of space propulsion systems. An effort is ongoing to develop an Engine Testing Facility Model which can run real-time prior to testing and during testing of an engine component.

Cryogenic Instrumentation:
Instrumentation is needed to precisely measure mass flow of cryogens from very low flow rates to very high flow rates at pressures to 15,000 psia. Research, technology, and development opportunities exist in developing instruments to measure fluid properties at cryogenic conditions during ground testing of space propulsion systems. Research technology and development opportunities also exist for instrumentation and methods of strain measurement at cryogenic temperatures.

Non-destructive Test and Evaluation:
Advanced instrumentation, methods, and techniques to conduct advanced non-destructive test and evaluation, failure analysis, and purity and cleanliness assessment are desired for the entire system to component levels. Research opportunities exist in acoustic emission, ultrasonics, high energy radiography in the non-destructive test and evaluation laboratory.

Exhaust Plume Diagnostics:
Research opportunities are available to quantify failure and wear and related plume code validation through vehicle health management/exhaust plume diagnostics experimentation. Exploratory studies are being conducted with emission/absorption spectroscopy, absorption resonance spectroscopy, and laser induced fluorescence.

Non-intrusive Remote Sensing:
Future propulsion system test techniques could employ non-intrusive sensors for acquiring measurements over wide areas instead of contact, intrusive sensors at a few discrete points. Opportunities exist in temperature, pressure, stress, strain, position, vibration, shock, impact, and other measured test parameters. The use of thermal infrared, ultraviolet, and multi-spectral sensors, imagers, and instru-

ments is possible through the SSC sensor laboratory.

Thermal Protection and Insulation Systems:
The test of liquid rocket systems employ very large flame buckets and diffusers to control, deflect, cool, condition, and reduce the sound level of the plume. Innovative thermal protection tiles, coating, or materials, and insulation systems could result in significant savings.

Propellant and Pressurants Conservation:
Large quantities of cryogenic fluids are used to bring propulsion systems and the test facility complexes from ambient temperatures to several hundred degrees Fahrenheit below zero. Research into operations techniques, recovery facilities and equipment, and energy management and conservation could likely improve ground testing to save money and energy.

Leak Detection:
Opportunities exist in hazardous (e.g., hydrogen) and non-hazardous leak detection technology to determine what is leaking, how much is leaking, where is the source of the leak, and how to model and visualize the extent of the effected area.

High Pressure/High Temperature Systems Studies:
Supersonic research aircraft will require technological advances in actively cooled and passive insulating materials for vehicle airframe and propulsion system components. Testing of these materials at SSC offers research opportunities in heat transfer, hot hydrogen, seal technology, thermal stresses, metal creep, and evaluation of materials after long duration exposure to high temperature and high acoustic energy.

Earth Science:
Use of remotely sensed data for research in archeology, tropical forest ecosystems, ecophysiology, biological oceanography, and interdisciplinary team studies of land:sea interface processes.

National Aeronautics and
Space Administration
Code EU
Washington, DC 20546-0001

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